final report

KEENLEYSIDE POWERPLANT PROJECT

VEGETATION, AGRICULTURE and FORESTRY STUDIES

for

B.C. HYDRO AND POWER AUTHORITY

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TALISMAN
Land Resource Consultants
300-842 Thurlow St.
VANCOUVER B.C.
V6E 1W2

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This impact assessment is based on the "Keenleyside Powerplant Project Engineering Description" prepared in November 1982. Since that time, ongoing planning and design studies have resulted in some changes that would affect the project description. The principal changes are as follows:

- In-service date has changed from 1992 to 1994 and the optional in-service date of 1990 is no longer being considered.

- Installed capacity has changed from 210 MW to 180 MW with corresponding changes to powerhouse design.

The above changes have been incorporated in the report only where they would affect the results of the impact assessment.

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CHAPTER 1
SUMMARY

An inventory of vegetation, agricultural and forestry resources in the Keenleyside Powerplant Project study area was conducted and impacts of project development on these resources was assessed. No unique vegetation is present and there are no active agriculture or forestry operations in the study area. The project involves no increase in areas inundated so that impacts are associated mainly with construction activities such as powerplant and camp construction, some road re-alignment, excavation of borrow materials and the disposal of spoil materials. Their proposed developments and disturbances are largely confined to areas that have already been severely and sometimes repeatedly disturbed over the last 15 to 20 years.

Impacts on existing vegetation are judged to be negligible; however, some suggestions for revegetation of spoil, borrow or otherwise disturbed areas are given. Development of a small rock quarry on the north side of the Robson-Broadwater Highway may result in the loss of up to about 1 ha of the land base, but no unique vegetation and negligible (if any) forestry values are affected.

Approximately 56 ha of land, located just east of Tulip Creek

in Syringa Creek Park, are within the Agricultural Land Reserve (ALR). However, there appears to be no potential for impact on agriculture from construction activities.

CHAPTER 2
INTRODUCTION

This study arose in response to a request, dated February 8, 1982, by the Environmental and Socio-Economic Services Department of B.C. Hydro for proposals to carry out the vegetation, agriculture and forestry components of the detailed feasibility assessment of the proposed Keenleyside Powerplant Project. In a letter of confirmation, dated March 17, 1982, Talisman Land Resource Consultants were contracted to provide these services.

The Talisman consultant principally responsible for the studies and impact assessment carried out in this project was Jace Standish, R.P.F. Wayne Biggs, M.Sc., and Susan Norman, M.Sc., provided input to the vegetation and agricultural study components respectively. Mr. Standish is the principal author of this report, and Dan Schroeter, P.Ag., acted as editor.

The terms of reference for the studies (see Appendix A) require both an inventory of the resources and industry of the study area and an assessment of the impacts of the proposed project on present and future use of these resources. The terms of reference also called for identification of opportunities for mitigating any adverse impacts caused by the project.

INTRODUCTION

The study area for the agriculture and forestry studies consists of all lands below elevation (EL) 500 metres above sea level (a.s.l.) adjacent to the Lower Arrow Lake from the Hugh Keenleyside Dam to a point 10 km west of the dam near Syringa Provincial Park (see Figure 1.1).

Methodologies used in this study are identical to those reported in the corresponding environmental studies of the Murphy Creek Project (Talisman, 1981). Similarly, regional overviews of the vegetation, agriculture and forestry resource bases are outlined in those studies.

The report that follows is the third draft of the Keenleyside vegetation, agriculture and forestry studies and supercedes all previous drafts. This draft incorporates revisions in response to review comments by Government and B.C. Hydro reviewers. The basis on which this report was written remains the program of field work and data compilation carried out in the spring of 1981.

The following report is presented in five sections. Chapters 3-5 provide detailed inventory descriptions of study area vegetation, agriculture, and forestry resources, and Chapter 6 presents an assessment of the possible impacts that the proposed hydroelectric project would have on future use of these resources. A set of appendices follows Chapter 6.

The reader is also referred to the Resource Atlas prepared for this project (Talisman Land Resource Consultants, 1982), which contains the mapping that was carried out in the inventory phase of these studies.

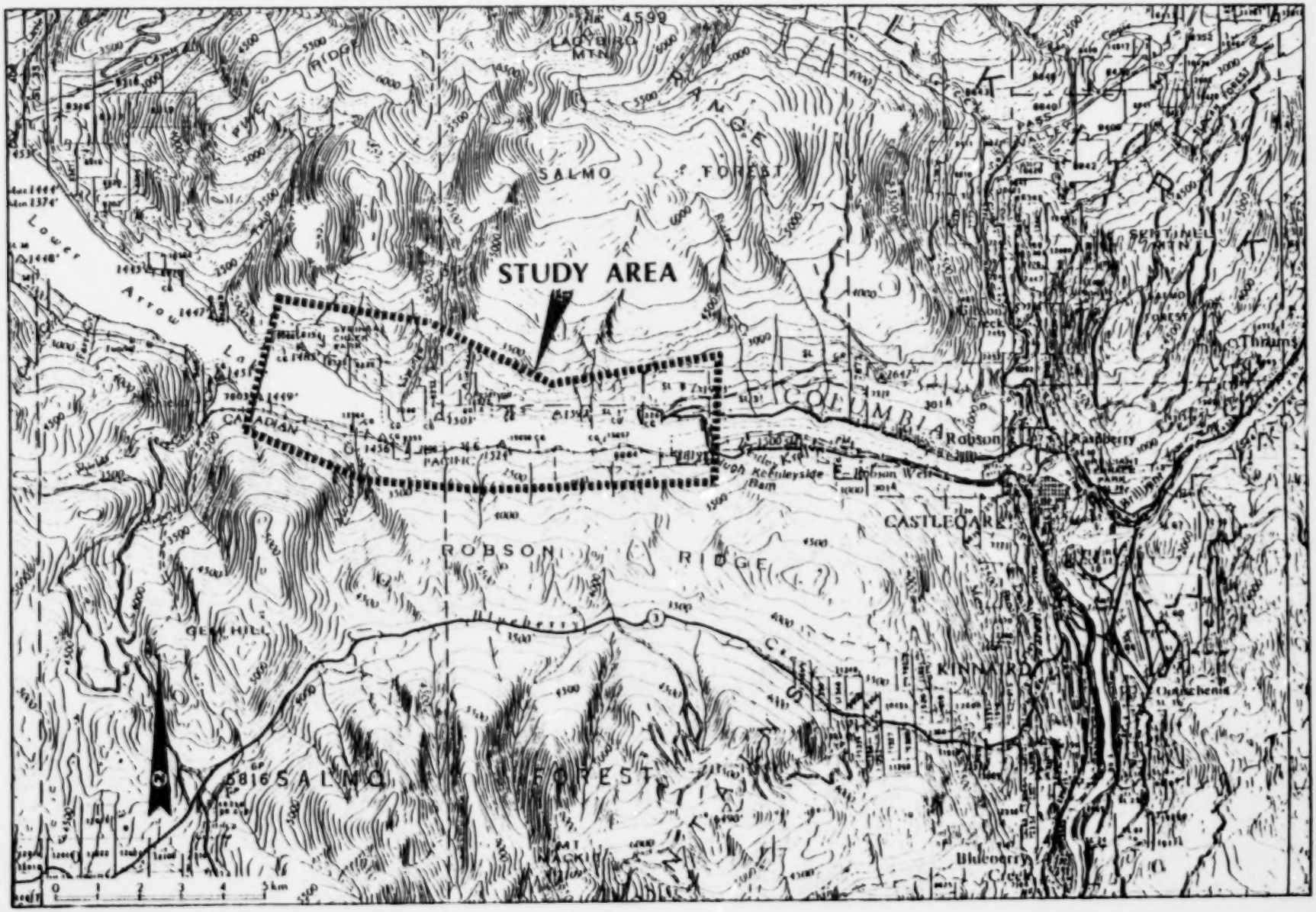

Figure 1.1 LOCATION OF STUDY AREA

CHAPTER 3
STUDY AREA VEGETATION

The study area is within the Interior Western Hemlock Biogeoclimatic Zone (Krajina, 1965 & 1969); however, the existing vegetation is composed mainly of second growth, mixed and coniferous forests and parklands, often with a relatively diverse species composition. These stands range in age from about 40 to 140 years old. Common tree species include white birch, lodgepole pine, ponderosa pine, western larch, western red cedar and Douglas-fir.

Appendix C presents a summary of the major plant species found within the Keenleyside-Murphy Creek study areas.

STUDY AREA OVERVIEW

Because of differences in site history as well as environmental differences, namely aspect, slope and soil parent materials, vegetation on the north and south sides of Arrow Lake shows some distinct differences. Moderately dense to dense forests dominated by western larch, Douglas-fir, lodgepole pine and white birch are common on the sheltered slopes of the south side where soil parent materials are predominantly coarse

textured colluvium. Open stands often occur on areas of shallow soils and bedrock outcrops.

The landscape on the north side is characterized by very steeply sloping terrain with morainal and colluvial soil parent materials of variable but often shallow depth along with frequent bedrock outcrops. Coarse textured fluvial materials often occur on the lower slopes; gently to moderately sloping fluvial fans and terraces occur in some places near the shoreline. The lower gentler slopes on the north side are often covered by moderately dense to dense forests of Douglas-fir and ponderosa pine along with some western larch and lodgepole pine. Steeper slopes with deep soils support open stands of Douglas-fir and ponderosa pine with a well developed understory dominated by pinegrass along with various shrubs and herbs. Mid to upper slopes or areas with shallow soils support a mosaic of parkland-like trees, shrubs and grass plant communities with ponderosa pine being the dominant tree species. Areas with numerous bedrock outcrops or which have been severely disturbed support shrub and grass communities with a sparse cover of ponderosa pine trees. Some small areas with somewhat sheltered aspects support small groves of immature trembling aspen and scattered white birch.

Only a few small areas of riparian tree and shrub plant communities occur in the study area. Recently disturbed areas along roadcuts, road rights-of-way and gravel pits are dominated by agronomic grass species and weedy herbs.

STUDY AREA VEGETATION

RIPARIAN AND LOWLAND VEGETATION

Severely disturbed, sparsely vegetated sites with a very low percent cover of agronomic grasses and weedy species such as knapweed and thistle occur in the drawdown zone of the Arrow Lakes Reservoir and in some settled areas along the Robson-Broadwater Highway. Other severely disturbed areas near the Hugh Keenleyside damsite and along the right-of-way support a more dense cover of these species along with bracken fern and, occasionally, shrub-size trembling aspen, white birch, bitter cherry and, less commonly, Douglas-fir, western red cedar, western larch or ponderosa pine.

Small areas of riparian tree and shrub communities occur near the mouth of Syringa Creek and in a few scattered locations along the south shore of Lower Arrow Lake. These areas are less than about 0.1 ha in extent and were therefore not mapped. Black cottonwood, white birch, trembling aspen and willows are the dominant species.

UPLAND VEGETATION

As discussed previously, some distinct differences exist between the upland vegetation on the south side of Lower Arrow Lake and that on the north side. It is convenient to discuss these two sections of the study area separately.

STUDY AREA VEGETATION

South Side Upland Vegetation

Most of the study area south of Lower Arrow Lake is covered with moderately dense to dense coniferous and mixed forests, approximately 60 to 120 years old. Although Douglas-fir, western larch, lodgepole pine and white birch are typically the dominant species, western hemlock, western red cedar and trembling aspen also occur and are sometimes locally abundant. Typical understory shrubs include Douglas maple, waxberry, prickly rose, mahonia, black blueberry, false box, thimbleberry and spreading dogbane. Common herbs are rattlesnake plantain, prince's pine, wintergreen, twisted stalk, false Solomon's seal and queen's cup. Mosses such as Polytrichum juniperinum and Dicranum species are often present.

A few areas of bedrock outcrops supporting sparse, but otherwise similar vegetation occur throughout this section of the study area. Disturbed areas along the Canadian Pacific Railway right-of-way are generally sparsely vegetated with agronomic grass species and weedy herbs.

North Side Upland Vegetation

Upland vegetation on the north side of Lower Arrow Lake in the study area consists of a mosaic of forest and shrub communities ranging from dense forests to open shrublands. Most lower, gentler slopes along the lakeshore and some tributary creeks are covered with moderately dense to dense, predominantly coniferous forests which are about 50 years old. Douglas-fir and ponderosa pine are the most abundant tree species but some lodgepole pine and western larch also occur. Western red cedar

and white birch occur occasionally and are usually confined to the lowest slope positions, gullies or local topographic depressions. The shrub layer is usually not strongly developed; typical shrub species are Douglas-fir, soopalallie, ocean spray, Saskatoon, prickly rose, red-stem ceanothus and mahonia. Pinegrass is the main understory species; others include yarrow and strawberry. Mosses such as Pleurozium schreberi, Rhytidiadelphus triquetrus and Dicranum species have a spotty occurrence and are most abundant on decaying wood, surface stones or in the more shaded microsites.

Steeper (30 to 55%) lower slopes with deep soils often support open forests of ponderosa pine and Douglas-fir. Shrub species in these stands are similar to those occurring on gentler slopes; however, the shrub layer is very poorly developed or absent except underneath denser clumps of trees. Mahonia, prickly rose, strawberry and yarrow are present in low cover. Mosses are very rare or absent and pinegrass is the dominant understory species occurring with a cover value of 50 to 75 percent.

Drier forested sites on upper slopes, with shallow soils or where soil coarse fragment content is especially great, are usually dominated by open forests of ponderosa pine which are floristically similar to the vegetation types described above.

Areas which have been severely disturbed, probably from wildfires, support parkland or shrub communities with many floristic affinities to the forest vegetation types. Ponderosa pine and, less commonly, Douglas-fir occur as scattered individuals or sometimes in small clumps. Shrub cover is variable and highest in sheltered or moist sites. Shrub species

include redstem ceanothus, Saskatoon, prickly rose, mahonia and birchleaf spirea. Hazelnut, white birch and trembling aspen occur occasionally in more moist or sheltered locations. Yarrow, strawberry, knapweed and Trifolium species have a scattered occurrence. Polytrichum mosses occur occasionally on exposed rock or mineral soil. Pinegrass occurs with a high cover except on steep areas of exposed bedrock.

RARE OR ENDANGERED PLANT SPECIES AND COMMUNITIES

No rare or endangered plant species or plant communities were noted during field work or are known to exist in the study area.

PLANT SPECIES LIST

A comprehensive list of plant species encountered in the Keenleyside or Murphy Creek study areas is contained in Appendix D. Most of the species listed have been referenced in the above discussion, with the exception of a few less commonly found species which appear only in the appendix.

CHAPTER 4
STUDY AREA AGRICULTURE

TERRAIN AND SOILS

The soils with the greatest potential for agriculture in the area are developed mainly on very coarse textured, gravelly fluvioglacial materials in the form of terraces at the higher elevations and fans and terraces deposited at the base of bedrock exposures along Lower Arrow Lake.

The terraces range from level to strongly sloping (0-15%). The terrace soils are often capped with a very thin (<5 cm) organic layer and are non-gravelly in the surface horizon and become very gravelly with depth. Cobbles frequently occur on the surface. These soils are well to rapidly drained.

The soils of the fan deposits are similar to those of the terraces, especially at the base of the fans; however, they become increasingly more gravelly and more steeply sloping towards the apex of the fan deposits. These soils are rapidly drained.

STUDY AREA AGRICULTURE

LAND CAPABILITY FOR AGRICULTURE

The study area is geographically located between Creston and Grand Forks and has a climate which is median between the two areas. The unimproved climatic capability for agriculture rating, based on information from the Trail (Warfield) station, is Class 5 with aridity limitations. This area experiences a droughty period between May and September during which the average precipitation is between 180 and 230 mm. This indicates a moisture deficiency during the growing season of about 270 mm. The improved or irrigated rating is Class 1 with a freeze-free period of roughly 184 days and growing degree days (above 5 C) of approximately 2,170 (B.C. Ministry of the Environment, 1978). The study area experiences warm summer months and average July temperatures of 21 C and fairly mild winters with January temperatures averaging -4 C (Province of British Columbia Land Reserve, 1974).

The better agricultural lands occur on the low lying terrace and fan deposits adjacent to Lower Arrow Lake. These landforms are very limited in extent. Only two such units of a sizeable area occur in the study area and these are located on the north side of the lake. One is located immediately west of the dam and the other is located in Syringa Creek Provincial Park, east of Tulip Creek.

The unit adjacent to the dam was disturbed during the construction of the dam and is not included in the Agricultural Land Reserve (ALR). The only ALR within the study area is located on and near the terrace and fan deposits just east of Tulip Creek in Syringa Creek Park. It encompasses approximately 56 ha and occupies portions of Lots 9068, 9154, 8232 and 8322.

STUDY AREA AGRICULTURE

The soils in the ALR have been previously assessed for agricultural capability and have been separated into two major units (Select Standing Committee on Agriculture, 1978). The soils developed on the lowlying terraces and the base of the fans have been mapped (improved with irrigation) as 70% Class 4 with topographic and soil moisture holding capacity limitations and 30% Class 3 with moisture holding capacity limitations. These Class 3 and 4 lands occupy 42 ha. The remainder of the ALR area has been mapped as 70% Class 6 with topographic and bedrock limitations and 30% Class 7 with bedrock and topographic limitations. This unit occupies approximately 14 ha and includes the apex of the fluvial fans, colluvial deposits and bedrock.

This mapping was carried out at a scale of 1:50 000 with little on-site investigation. The findings of the air photo interpretation and on-site investigations carried out in this study are generally in agreement with the previous mapping except that the recent findings indicate that the terrace and fan soils may also be limited by stoniness.

The Class 3 soils should be capable of supporting some vegetables such as cabbage and Brussels sprouts as well as small fruits such as raspberries and strawberries, tree fruits, cereals and forage crops. The Class 4 soils should be capable of supporting tree fruits, cereals and forage crops. The remaining areas are unsuitable for cultivation although they could be used, along with the arable lands, as native range for cattle grazing.

CHAPTER 5
STUDY AREA FOREST RESOURCES

FOREST TENURE AND PRESENT USE

The study area is within the Salmo Block of the Arrow Timber Supply Area (TSA) which is administered by the B.C. Ministry of Forests through the Castlegar district and Nelson regional offices. There are no active logging or milling operations within the study area. An up-to-date list of the thirteen licensees in the Arrow TSA is included in Appendix E. The western end of the study area adjoins the southern boundary of the Little Slocan Tree Farm Licence, TFL 3, held by Slocan Forest Products Ltd.

FOREST COVER

Potentially merchantable coniferous tree species occurring in the study area are Douglas-fir, lodgepole pine, ponderosa pine, western hemlock, western larch and western red cedar. White birch is the most abundant and widespread deciduous species; trembling aspen and black cottonwood are much less abundant but occur as a minor component of some stands.

STUDY AREA FOREST RESOURCES

The age of forest stands in the study area ranges from about 40 to 140 years and most stands are classified as immature (less than 121 years old). However, many of these stands, particularly those on the south side of Lower Arrow Lake, are above the minimum cutting age of 60 years specified by the B.C. Ministry of Forests (1980).

Detailed timber cruise and forest productivity information are not available for the study area and were not requested to be collected as part of this study. Based on existing forest inventory data (Spandli, 1976), aerial photo interpretation and an overview field reconnaissance, it is estimated that adequately stocked, mature coniferous stands in the study area have merchantable volumes ranging from about 140 to 210 cubic metres per hectare (net volume at B.C. Ministry of Forests' close utilization standards with allowance for decay).

As mentioned in Chapter 2, forest types in the study area show some distinct differences between the north and south sides of Lower Arrow Lake. It is therefore convenient to discuss some aspects of forest cover separately for these two contrasting areas. Table 5.1 summarizes forest cover according to three general types, mature, immature and non-forest, for the total study area and for the north and south sides separately.

South Side of Lower Arrow Lake

As shown in Table 5.1, the south side of the study area is covered almost entirely (99% of the area) by mature and immature forests; mature forest comprises 36% (89 ha) of the area and immature forest covers 63% (155 ha) of the area.

TABLE 5.1
SUMMARY OF STUDY AREA LANDS
BY PRESENT FOREST COVER

COVER TYPE[a]	NORTH SIDE ARROW LAKE		SOUTH SIDE ARROW LAKE		STUDY AREA	
	AREA(ha)	%	AREA(ha)	%	AREA(ha)	%
MATURE	6	2	89	36	95	18
IMMATURE	162	59	155	63	317	61
NON-FOREST	107	39	2	1	109	21
TOTALS	275	100	246	100	521	100

a. Cover types:

Mature: greater than 120 years old

Immature: less than 120 years old

Non-forest: cultivated, rock

Nearly all of the immature stands are 60 years of age or more. Both mature and immature stands are composed of mixtures of Douglas-fir, western larch, lodgepole pine and white birch. Western red cedar and western hemlock also comprise a significant component of some stands.

Minor areas of non-forest cover occur on steep rock outcrops and along the Canadian Pacific Railway right-of-way.

North Side of Lower Arrow Lake

Mature and immature forests comprise 61 percent of the north side of the study area including 6 hectares of mature forest and 162 hectares of immature forest. The small area of mature forest occurs in the western portion of the study area between Syringa and Tulip Creeks near the elevational boundary of the study area (500 m a.s.l.) and is composed of a mixture of ponderosa pine and Douglas-fir ranging in age from about 120 to 150 years.

Immature stands are composed mainly of mixtures of ponderosa pine and Douglas-fir along with relatively minor amounts of lodgepole pine and western larch. White birch may be locally abundant in some stands. Most of the immature stands are approximately 40 to 60 years old.

Non-forest cover, consisting mainly of non-productive brush types, occupies 107 hectares in this part of the study area. Some relatively extensive areas of this cover type occur along the Robson-Broadwater Highway near the Hugh Keenleyside Dam and between Allandale and Syringa Creeks.

FOREST CAPABILITY

Forest capability according to the Canada Land Inventory (CLI) capability classification ranges from Class 3 (5.0 to 6.3 cubic metres per hectare per year) to Class 7 (0.0 to 0.7 cubic metres per hectare per year) but class 4 lands (3.6 to 4.9 cubic metres per hectare per year) comprise by far the largest portion of the study area. This contrasts with the net mean annual increments (MAI's) for existing immature timber types in the study area, as reported in the B.C. Ministry of Forests' inventory data (Spandli, 1976), which range from about 0.3 to 3.0 cubic metres per hectare per year (at B.C. Ministry of Forests' close utilization standards with allowance for decay). The difference in MAI's results from the assumptions in CLI capability classification that stands are fully stocked with the most suitable tree species and because MAI figures in the CLI classification make no allowance for utilization limits or losses from decay.

A summary of forest capability within the study area is presented in Table 5.2. Class 4 lands cover 340 hectares representing 65 percent of the study area. Class 3 lands cover a total of 88 hectares, comprising 17 percent of the study area. On the south side of Lower Arrow Lake they are associated with deep deposits of colluvial and fluvial soil parent materials on north-facing lower slopes. On the north side of Lower Arrow Lake they occur on lower-lying areas of fluvial landforms in close association with Class 4 lands near the Hugh Keenleyside damsite. Soil moisture deficiency is indicated as the major factor limiting productivity on Class 3 and 4 lands.

TABLE 5.2
SUMMARY OF STUDY AREA LANDS
BY CLI FOREST CAPABILITY CLASSES[a]

CLI CAPABILITY CLASS	NORTH SIDE ARROW LAKE AREA(ha)	%	SOUTH SIDE ARROW LAKE AREA(ha)	%	STUDY AREA AREA(ha)	%
3	24	9	64	26	88	17
4	168	61	172	70	340	65
5	26	9	10	4	36	7
6	40	15	-	-	40	8
7	17	6	-	-	17	3
TOTALS	275	100	246	100	521	100

a. CLI forest capability classes:

Class 3: 5.0 - 6.3 m /ha/yr

Class 4: 3.6 - 4.9 m /ha/yr

Class 5: 2.2 - 3.5 m /ha/yr

Class 6: 0.8 - 2.1 m /ha/yr

Class 7: 0.0 - 0.7 m /ha/yr

Some class 4 lands on southerly aspects are also limited by exposure.

Class 5 lands occur on both the north and south sides of Lower Arrow Lake and cover a total of 36 hectares, representing 7 percent of the study area. Class 5 lands are limited by shallow rooting depth, soil moisture deficiency and, on some southerly aspects, exposure.

Class 6 and 7 lands cover 57 hectares, comprising 11 percent of the study area, and occur only north of Lower Arrow Lake on south facing slopes with shallow soils and rock outcrops. Shallow rooting depth and exposure are indicated as the factors limiting productivity on these lands.

CHAPTER 6
IMPACT ASSESSMENT

The following assessment of possible impacts stemming from the proposed construction and operation of the Keenleyside Powerplant Project is derived from the inventory information presented in the preceding chapters and the Engineering Description report for the project (B.C. Hydro, 1982).

IMPACT TYPES

In general, the engineering description of the project, indicates that impacts may be associated with land disturbances due to the following:

* powerplant construction, including access roads and realignment of the Robson-Broadwater Highway.

* excavation of borrow materials required for construction

* use of an area near the proposed powerplant as a construction site for a period of approximately 5 years.

* disposal of spoil materials produced by the construction

IMPACT ASSESSMENT

The proposed powerplant facilities would not result in any increase in inundation under either operating regime. Although the two operating regimes discussed by B.C. Hydro differ in duration of maximum and minimum reservoir levels and discharge, the differences do not appear to be great enough to identify impacts of vegetation, agriculture or forestry which are unique to one regime or the other. It is noted, however, that the amount and duration of drawdown is less for operating regime 2.

The following sections discuss possible impacts with respect to the vegetation, agricultural and forestry resources of the study area.

VEGETATION IMPACTS

All of the areas that would be affected by the proposed project have already been highly disturbed. Further vegetation impacts would be minimal.

Impacts of Powerplant Construction

Approximately 5 ha of vegetation would be lost to construction of the powerplant and ancillary developments including new access roads and realignment of portions of the Robson-Broadwater Highway. Almost all of this area is already highly disturbed, covered mainly with agronomic grass species, knapweed, and bracken fern. A minor portion of a vegetation unit, consisting of Saskatoon, with aspen and birch shrubs, agronomic grass species and native, weedy herbs may also be

affected.

In the area of the highway realignment, a minor area (up to about 0.2 ha) of moderately dense, immature (approximately 40 years old), predominantly coniferous forest may be lost due to the realignment.

Vegetation impacts due to powerplant construction, while permanent, are considered minor because repeated past disturbances have already resulted in predominantly weedy vegetation dominating the area.

Impacts of Borrow and Spoil Areas

The engineering description (B.C. Hydro, 1982) mentions seven borrow and/or spoil areas designated as Areas 3, 4, 5, 6, 7, 9, 10, 11 and 12. A rock quarry area (Area 8) is also shown. Areas 3, 4, 5, 6, 7 and 10, located on the south side of the Robson-Broadwater Highway, are in already highly disturbed vegetation consisting mainly of agronomic grass species, knapweed, bracken fern and other weedy herbs with some scattered individuals or patches of shrub-size white birch, trembling aspen, Douglas-fir and ponderosa pine. Areas 11 and 12, located on the north side of the Robson-Broadwater Highway, are old borrow areas with sparse, weedy vegetation. Given the nature of the vegetation types, the loss of vegetation associated with these spoil and borrow areas represents a negligible impact. (comments regarding Area 3, near the north end of the damsite, have been addressed in the previous discussion on the impacts of powerplant construction).

Similar comments apply to the Balfour till excavation sites (Area 9) located outside of the study area. The natural vegetation on these sites has already been removed while obtaining impervious fill material for construction of the Hugh Keenleyside Dam.

Area 8, a proposed quarry located on the north side of the Robson-Broadwater Highway covers an area of approximately 1 ha. A part of the area, covering less than 0.5 ha, will affect some open ponderosa pine and Douglas-fir forest. However, this vegetation is common in the study area and the impact on loss of existing vegetation is therefore considered negligible. However, the area developed as a quarry does represent a permanent loss to the land base unless intensive and costly reclamation was undertaken.

Impacts due to borrow or spoil creation are not considered permanent as the sites will revegetate, either naturally or possibly through reclamation programs.

Since surficial materials in those borrow and spoil areas occurring near the north shore of Lower Arrow Lake (i.e., Areas 4, 5, 6, 7 and 10) are apparently very coarse textured, erosion and siltation should not be serious if reasonable construction procedures, such as those outlined in the Engineering Description (B.C. Hydro, 1982, p. 6-7), are followed.

The potential for spread of knapweed in spoil areas or other disturbed areas may be of concern; however, the areas likely to be affected are not rangelands and the species is already present in low-lying, disturbed areas along much of the north shore of Lower Arrow Lake.

Impacts of Construction Camp Development

It is proposed to locate a construction camp on the north bank of the Columbia River about one-half kilometre downstream from the dam (B.C. Hydro, 1982). This area is currently highly disturbed and supports vegetation with a variable cover of agronomic grasses, knapweed and other weedy species. The direct impact of disturbance or destruction of this vegetation would be negligible and of short term duration.

Mitigation

Upon completion of operations, borrow sites, spoil areas and the campsite should be revegetated. A grass-legume seed mixture of intermediate wheatgrass, smooth brome, Canada bluegrass, creeping red fescue, climax timothy, alfalfa, white Dutch clover and sweet clover sown at a rate of about 30 kilograms per hectare would probably be satisfactory for initial, rapid revegetation. At least for aesthetic reasons consideration might also be given to carrying out some planting of trees and shrubs in the campsite as well as the borrow and spoil areas near the Robson-Broadwater Highway.

Native tree species such as ponderosa pine and Douglas-fir should be suitable in most areas. Black locust (an introduced species which grows in nearby areas) may also be of interest because of its ability to add nitrogen to the soil and its proclivity for relatively rapid spread by root suckering.

Revegetation of the drawdown zone appears to be problematic. Most of the existing areas support very sparse vegetation, or none at all. In some areas, maintenance of beach areas for recreation may over-ride revegetation concerns. Because of the coarse textured surficial materials, erosion is probably not a major problem in the drawdown zone. Therefore, the most reasonable course of action at the present time seems to be to leave these areas as they are.

AGRICULTURE IMPACTS

Presently there is no active agriculture being carried out in the study area. Approximately 56 ha of land just east of Tulip Creek in Syringa Creek Park have been placed within the ALR.

There does not appear to be a potential for impact on agriculture by the construction activities as the lands designated for agriculture are located considerably to the west of the proposed construction site.

Reclamation of Proposed Borrow and Spoil Pits for Agriculture

The proposed borrow and spoil sites appear to have very little if any potential for agricultural use. On this basis, reclamation for the benefit of agriculture is not seen as a requirement.

Impacts of Camp Construction and Operation on Agriculture

The proposed construction camp location is on the former dam construction campsite. As the soils already have been disturbed by former construction activities this appears to be the most suitable location for the new camp. This area is not within the ALR and has no capability for arable agriculture in its present state and little scope for agricultural reclamation.

IMPACTS ON TIMBER VALUES

Impacts of Powerplant Construction

The impact of the proposed powerplant adjacent to the Hugh Keenleyside Dam on the north side of Lower Arrow Lake should be negligible with regard to timber values. Most of this area has already been severely disturbed and is not forested.

In the area of the highway realignment, minor areas of immature Douglas-fir, western larch, and white birch may require clearing. These stands are presently non-merchantable.

Impacts of Borrow Excavation

Nearly all of the proposed borrow and spoil areas are not forested and no impacts on timber values would occur in this area.

Excavation from the existing Balfour till borrow areas as shown

in the Engineering Description (B.C. Hydro, 1982) should have no impact on timber values. The surrounding timber consisting mainly of immature coniferous and mixed forests of Douglas-fir, western larch, ponderosa pine, lodgepole pine, white birch and trembling aspen ranging in age from about 40 to 80 years will not be affected.

Other Potential Impacts

Establishment of the construction campsite on the north side of Lower Arrow Lake near the damsite would have no effect on timber values; the area is not forested. Similarly the possible spoil disposal area upstream of the damsite involves no timber values.

IMPACTS ON FOREST CAPABILITY

All of the lands in the vicinity of the damsite and potentially affected by the proposed project have forest capability ratings of Class 3 or Class 4. However, none of these areas is within the Arrow Timber Supply Area, no areas are being managed for forest production and practically no immature growing stock is affected. In the absence of the project it is unlikely that these areas would ever be managed for forest production.

The proposed Balfour till borrow areas are located on lands originally classified by the Canada Land Inventory as Classes 4 and 5. It is not known to what extent the till excavation that has taken place to date has diminished this capability. However, it is likely that these lands could be reclaimed for

forestry after till excavation is complete. The impact of the proposed project on these lands is, at worst, a postponement for about 5 years, of their reclamation for forest use.

RECLAMATION POTENTIAL

Reclamation of borrow pits, spoil areas and the construction campsite in the vicinity of the Keenleyside dam to productive forest land is not considered to be a viable option since this land has not been managed as forest land and probably will not be in the forseeable future. The Balfour till sites are within the Arrow TSA and once supported some moderately productive, mixed, immature stands of Douglas-fir, ponderosa pine and white birch. However, the cost of reclaiming these borrow sites to productive forest land is much greater than the expected value of any timber that could be produced.

APPENDIX A
TERMS OF REFERENCE

SECTION B - VEGETATION, AGRICULTURE AND FORESTRY

1.0 OBJECTIVES

1. To extend the Murphy Creek Resource Atlas to cover areas potentially affected by the Keenleyside Generation Project.

2. To identify potential impacts of the project on vegetation, agriculture and forestry.

2.0 METHODOLOGY

(a) Inventory

Using the same symbols and format as the Murphy Creek Resource Atlas, map vegetation, agriculture and forestry information within the study area.

(b) Assessment

1. Discuss the effects, if any, of Keenleyside construction and operation on vegetation, agriculture and forestry.

2. Discuss reclamation of the proposed borrow areas in terms of benefits (if any) to vegetation, agriculture or forestry.

3. Provide input to the campsite study with respect to impacts of alternative camp locations on vegetation, agriculture or forestry.

APPENDIX B
REFERENCES

REFERENCES

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APPENDIX C
PLANT SPECIES IN DOMINANT VEGETATION TYPES

SUMMARY OF DISTRIBUTION OF PLANT SPECIES
IN DOMINANT VEGETATION TYPES
KEENLEYSIDE AND MURPHY CREEK STUDY AREA

	FLOODPLAIN AND LOWLANDS	ROCKY OUTCROPS	ABANDONED AND/OR DISTURBED LAND	LOWER SLOPES AND BENCHES
TREES:				
Black cottonwood	2			+
White birch	+	+	+	2
Douglas maple	1			+
Black hawthorn	+			
Aspen	+	+	+	+
White pine		1		1
Ponderosa pine		1		1
Lodgepole pine		1		1
Western red cedar	1			+
Western larch				1
Western hemlock				+
Douglas-fir	+	+		1
Grand fir				+
Rocky Mtn. juniper	+			
Western yew	+			+
SHRUBS:				
Thimbleberry	1	1	1	
Redstem ceanothus	1	+		1
Ocean spray		1		+
Saskatoon berry	1	2		+
Hazelnut	1	1	1	1-2
Red elderberry	+			+
Black blueberry	+			+
Waxberry	1	+		1
Mahonia	1	+		1
Spreading dogbane	1	+	+	1
HERBS & LOW SHRUBS:				
Grasses	+	2	2	+
Twinflower				1
Bearberry	1	1	+	+
Poison Ivy		1	+	
Queen's cup	1			1
Rattlesnake plantain	1			1
Star-flowered Solomon's seal	1			+
Knapweed			2	
Bluebell	1			+
Lupine		+		1
Sarsaparilla	+			

KEY: 1 denotes <25% cover
2 denotes 25-75% cover
3 denotes >75% cover
+ denotes species present, undetermined cover

APPENDIX D

LIST OF PLANT SPECIES
KEENLEYSIDE AND MURPHY CREEK
STUDY AREAS

LIST OF PLANT SPECIES

KEENLEYSIDE AND MURPHY CREEK STUDY AREAS

Common Name	Scientific Names
Trees	
bitter cherry	Prunus emarginata (Dougl.) Walp.
black cottonwood	Populus balsamifera L. spp. trichocarpa (Torrey & Gray) Brayshaw
black hawthorn	Crataegus douglasii Lindl.
Douglas-fir	Pseudotsuga menziesii (Mirbel) Franco var. glauca (Beissn.) Franco
Douglas maple	Acer glabrum Torr.
Engelmann spruce	Picea engelmannii Parry
grand fir	Abies grandis (Dougl.) Forbes
hazelnut	Corylus cornuta Marsh.
lodgepole pine	Pinus contorta Dougl. var. latifolia Engelm.
mountain alder	Alnus tenufolia Nutt.
ponderosa pine	Pinus ponderosa Laws.
Rocky Mountain juniper	Juniperus scopularum Sarg.
subalpine fir	Abies lasiocarpa (Hook.) Nutt.
trembling aspen	Populus tremuloides Michaux
western hemlock	Tsuga heterophylla (Raf.) Sarg.
western larch	Larix occidentalis Nutt.
western red cedar	Thuja plicata Donn
western white pine	Pinus monticola Dougl.
western yew	Taxus brevifolia Nutt.

Common Names	Scientific Names
whitebark pine	Pinus albicaulis Engelm.
white birch	Betula papyrifera Marsh.
willow	Salix spp.
Shrubs	
black blueberry	Vaccinium membranaceum Dougl.
blue clematis	Clematis columbiana T. & G.
Canada buffalo berry	Shepherdia canadensis (L.) Nutt.
devil's club	Oplopanax horridus (Smith) Miq.
honeysuckle	Lonicera ciliosa (Pursh) DC.
Hudson Bay currant	Ribes hudsonianum Richards.
mallow ninebark	Physocarpus malvaceus (Greene) Kuntz
mock orange	Philadephus lewisii (Pursh)
oak fern	Gymnocarpium dryopteris (L.) Newm.
ocean spray	Holodicus discolor (Pursh) Maxim.
prickly rose	Rose acicularis Lindl.
red elderberry	Sambucus racemosa L.
red osier dogwood	Cornus stolonifera Mischx.
redstem ceanothus	Ceanothus sanguineus Pursh
Saskatoon berry	Amelanchier alnifolia Nutt.
spreading dogbane	Apocynum androsaemifolium L.
thimbleberry	Rubus parviflorus Nutt.
waxberry	Symphoricarpus albus (L.) Blake
Herbs and Low Woody Shrubs	
bearberry	Arctostaphylos uva-ursi (L.) Spreng.

Common Names	Scientific Names
birch-leaf spirea	Spirea betulifolia Pall.
bluebell	Campanula rotundifolia L.
bluebunch wheatgrass	Agropyrum spicatum (Pursh) Scribn. & Smith
bracken fern	Pteridium aquilinum (L.) Kuhn.
butter and eggs	Linaria vulgaris Hill
butter cup	Ranunculus spp.
cattail	Typha latifolia L.
creeping mahonia	Mahonia repens Lindl.
false box	Pachistima myrsinites (Pursh) Raf.
false Solomon's seal	Smilacina racemosa (L.) Desf.
fireweed	Epilobium angustifolium L.
forget-me-not	Myosotis sylvatica Hoffm.
great mullein	Verbascum thapsus L.
grouseberry	Vaccinium scoparium Leiberg
heart-leaved arnica	Arnica cordifolia Hook.
Hooker's fairy bells	Disporum hookeri (Torr.) Nicholson
horsetail	Equisetum arvense L.
indian pipe	Monotropa uniflora L.
knapweed	Centaurea spp.
lupine	Lupinus spp.
mahonia	Mahonia aquifolium (Pursh) Nutt.
nodding onion	Allium cernuum Roth
northern bedstraw	Galium boreale L.
pinegrass	Calamagrostis rubescens Buckl.
poison ivy	Rhus radicans L.

Common Names	Scientific Names
prince's pine	Chimpahila umbellata (L.) Bart.
purple aster	Aster conspicuus Lindl.
purple vetch	Vicia spp.
queen's cup	Clintonia uniflora (Shult.) Kunth
rattlesnake plantain	Goodyera oblongifolia Raf.
rushes	Juncus spp.
sarsaparilla	Aralia nudicaulis L.
sedge	Carex spp.
skunk cabbage	Lysichitum americanum Hulten & St. John
star-flowered Solomon's seal	Smilacina stellata (L.) Desf.
stonecrop	Sedum spp.
strawberry	Fragaria virginiana Duchesne
strawberry blite	Chenopodium capitatum (L.) Aschers.
thistle	Cirsium spp.
twinflower	Linnaea borealis L.
twisted stalk	Streptopus amplexifolius (L.) DC.
western teaberry	Gaultheria ovatifolia Gray
western fescue	Festuca occidentialis Hook.
wintergreen	Pyrola asarifolia Michx.
yarrow	Achillea millefolium L.

Common Names	Scientific Names
Mosses and Lichens	
	Cladina sp. (lichen)
	Dicranum spp. (moss)
	Mnium sp. (moss)
	Peltigera sp. (lichen)
	Pleurozium schreberi (Brid.) Mitt. (moss)
	Rhytidiadelphus triquetrus (Hedw.) Warnst.

APPENDIX E

LICENSEES IN THE ARROW TSA

APRIL 1982

LICENSEES IN THE ARROW T.S.A.

Atco Lumber Ltd.
Box 369
Fruitvale, B.C.
V0G 1L0

BC Timber Ltd.
Box 1000
Nakusp, B.C.
V0G 1R0

Bell Pole Co. Ltd.
Box 339
Lumby, B.C.
V0E 2G0

Glenmerry Sawmills Ltd.
Box 398
Trail, B.C.
V1R 4L7

Hadikin Bros. Lumbering Ltd.
Box 369
Fruitvale, B.C.
V0G 1L0

Hearn Bros. Lumber Company Limited
Box 369
Fruitvale, B.C.
V0G 1L0

Kalesnikoff Lumbering Co. Ltd.
Box 3000
Thrums, B.C.
V1N 3L4

Lavington Planer Mill Ltd.
Lavington, B.C.
V0E 2B0

Louisiana-Pacific Canada Limited
Box 40
Salmo, B.C.
V0G 1Z0

Pope & Talbot Ltd.
Box 39
Grand Forks, B.C.
V0H 1H0

Riverside Forest Products Limited
Box 370
Lumby, B.C.
V0E 2G0

Slocan Forests Products Ltd.
Slocan, B.C.
V0G 2C0

Weyerhaeuser Canada Ltd.
Box 10
Lumby, B.C.
V0E 2G0

POOR

QUALITY

ORIGINAL